



The Open University

MS221
Exploring Mathematics

MS221 Guide

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1 Introduction

Welcome to MS221 *Exploring Mathematics*. We hope that you will find it enjoyable and rewarding!

This *MS221 Guide* gives you an overview of the learning outcomes, components, assessment and study support, to help you to plan your study.

If you are studying MST121 and MS221 together, then you will have received preparatory materials. If you are studying only MS221, then the most useful revision material for this is Blocks A, B and C of MST121. You should also have an appropriate computer running *Windows*, and be familiar with the basic operation of *Windows*.

On successful completion of MS221, you will be well prepared to study further mathematics modules as well as other modules that *use* mathematics. You will also have gained experience in using mathematical software, and should have developed general skills for learning and communicating mathematics.

2 Learning outcomes

The following list of outcomes indicates what you should be able to do by the end of MS221.

Knowledge and understanding

You should be able to:

- ◇ extend your familiarity with an increased range of mathematical language and objects
- ◇ develop new ideas and extend your ways of mathematical thinking
- ◇ develop an appreciation of the need for justification or proof.

Cognitive skills

You should be able to:

- ◇ increase your range of mathematical language and knowledge of mathematical objects
- ◇ work with a greater range of mathematical objects using coordinate geometry, including conic sections
- ◇ develop your work with matrices to include matrix transformations and diagonalisation
- ◇ perform more difficult differentiation and integration
- ◇ work with some pure mathematical ideas such as complex numbers and basic groups
- ◇ be able to write certain types of mathematical proof, and to use the concept of a counter-example.

Key skills

You should:

- ◇ develop further your own learning and performance (e.g. ability to organise study time, to study independently, to learn from feedback, to meet deadlines)
- ◇ develop further skills for communicating mathematical ideas
- ◇ begin to appreciate mathematical proof and be able to write down some simple proofs
- ◇ develop further your skills in the use of a computer algebra package (Mathcad).

Practical and/or professional skills

You will gain further experience with the use of a computer algebra package (Mathcad), and with logical and mathematical argument.

Your understanding of basic principles and concepts, and the use of techniques, is assessed through TMA questions and an examination. Some questions involve a directed solution to a longer problem, but some other questions give less direction.

Written communication is assessed in the TMAs and in the examination. Improving your own performance is implicit in MS221 and not explicitly assessed. In many questions credit is given for clarity of presentation.

Evidence of computer work is required as part of TMA answers. You may be asked to interpret a Mathcad printout in the examination.

3 Components

The main MS221 components are described below.

Study texts

MS221 is made up of four **blocks** of study:

- Block A Mathematical exploration
- Block B Exploring iteration
- Block C Calculus
- Block D Structure in mathematics

Each block is divided into several individually bound **chapters**, and has associated with it an **exercise booklet** containing exercises and solutions. There is also a book called **Computer Books A–D**, which contains software-based activities for all chapters.

Most chapters in MS221 contain the following elements:

- a **study guide**, which gives information on the structure of the chapter, and an **introduction**
- several **sections**, with **examples**, **activities** and **comments** on those activities, a **section summary**, and **exercises** to provide practice
- a **chapter summary**, including a statement of **learning outcomes**
- **solutions** to activities and exercises.

Some chapters include a **block introduction** or a **block summary**, and some contain an **appendix** related to particular teaching sections.

Your study will be guided by the chapters, and much of your study time will be spent working directly from them. You will gain most benefit from your study if you work with a pencil and paper to hand, reading the chapters, annotating them and making your own notes. We advise you to keep these notes, and others that you make (for example, notes from tutorials and your rough drafts of assignments), in a ring binder or notebook, for ease of reference.

You should also have your calculator and the MS221 **Handbook** available.

Some sections and their activities require the use of resources beyond the chapters themselves. These resources are specified in the chapter study guides, and their associated icons (see below) appear at the beginning of the appropriate sections.



indicates that you will need your computer



indicates that you will need audio CD playback equipment



indicates that you will need DVD playback equipment

In addition, there may be times other than those specified when you wish to use your computer to check something. When using your computer, do avoid sitting at the screen for long periods without a break, and keep a pencil and paper to hand for any notes that you need to make.

On average, most students are able to study an MS221 chapter in about 15 hours, including working through the associated computer work, audio-visual material and the relevant assignment questions. If you studied MST121 previously, you may need to look back at some of the material to review your knowledge before working through a chapter of MS221. If you are studying MS221 and MST121 simultaneously, you will have the advantage that all the material will be fresh in your mind, but there will be very little opportunity to relax, as you need to study a chapter from one module or the other every week. As with MST121, the material in Block C is very important to future modules in mathematics, physics and electronics. In Block D you will tackle some ideas from an area generally known as pure mathematics. In particular, some simple methods of mathematical proof are introduced.

Calculator

You need a scientific or graphics calculator for parts of MS221, and for the examination. If you are not familiar with your calculator, then you should practise using it with the help of its manual, preferably before MS221 begins.

Note that there are restrictions as to what sort of calculator can be taken into the examination. See the MS221 website for further details.

Computer software

The software package Mathcad and associated files are supplied on the CD-ROMs used in MST121. The process of installing Mathcad is described on the MS221 website, which also includes troubleshooting advice. The activities associated with these files are given in the computer book. The document *A Guide to Mathcad* provides a source of reference to the features of Mathcad used in MS221.

If you have not studied MST121, you will be sent Chapter A0, *A Guide to Mathcad* and the two CD-ROMs containing Mathcad and associated files in a separate mailing.



Audio bands

Audio bands are used in some parts of MS221, to talk you through material printed in the text. Do stop, start and replay these bands as often as necessary.



Video bands



The DVDs include video bands of various types. Some of the bands are linked directly to the main MS221 texts, and should be used when indicated by these texts and on the *Study planner* (see below). The 'Algebra workout' bands cover more general techniques in algebra, taking you through the basics step-by-step.

<i>Band A(i)</i>	<i>Algebra workout: Rearranging formulas</i>
<i>Band A(ii)</i>	<i>Algebra workout: Square roots</i>
<i>Band A(iii)</i>	<i>Visualising conics</i>
<i>Band A(iv)</i>	<i>Algebra workout: Trigonometry</i>
<i>Band A(v)</i>	<i>Visualising isometries</i>
<i>Band B(i)</i>	<i>Algebra workout: Binomial Theorem</i>
<i>Band B(ii)</i>	<i>Algebra workout: Finding matrix transformations</i>
<i>Band B(iii)</i>	<i>Algebra workout: Eigenvectors</i>
<i>Band B(iv)</i>	<i>Weaving spirals</i>
<i>Band C(i)</i>	<i>The birth of calculus</i>
<i>Band C(ii)</i>	<i>Algebra workout: Differentiation</i>
<i>Band C(iii)</i>	<i>Integration</i>
<i>Band C(iv)</i>	<i>Algebra workout: Integration</i>
<i>Band C(v)</i>	<i>Algebra workout: Taylor polynomials</i>
<i>Band D(i)</i>	<i>Algebra workout: Complex numbers</i>
<i>Band D(ii)</i>	<i>Roots of polynomials</i>
<i>Band D(iii)</i>	<i>Algebra workout: Modular arithmetic</i>
<i>Band D(iv)</i>	<i>Algebra workout: Mathematical induction</i>

Supplementary video material

A series of fifteen video bands on two DVDs is associated with MST121 and MS221. You are likely to find all of these programmes interesting and enriching as you study, but some are more explicitly associated with MS221 chapters. The first DVD comprises eight bands of general interest; the second DVD has four bands for MST121 and three for MS221.

Study planner

On the MS221 website there is an online *Study planner* that gives the recommended starting date for each chapter and the dates when the assignments are due. It also gives schedules for the audio and video bands.

Many MS221 tutors offer a programme of tutorials that are designed to aid your study of MS221. Some tutorials are face-to-face meetings; others take place online. If your tutor is offering tutorials, the dates will be given on the *Study planner*. You are also welcome to attend tutorials given by other MS221 tutors; you can find details of these by using the online Tutorial Finder, or by contacting the Learner Support Team at your Regional Centre. It is always worth double-checking the online Tutorial Finder the day before a tutorial in case of any changes.

Handbook

The MS221 *Handbook* contains a list of notation and a glossary of technical terms, arranged alphabetically, together with key results and formulas, organised according to the chapter in which they appear.

The *Handbook* is a key source of reference throughout MS221. You are allowed to take it into the examination, and you can add your personal annotations to it. However, there are restrictions to the sort of annotations you can make if you want to take your *Handbook* into the examination, so please read the information on the MS221 website carefully. In theory, therefore, there is no need to memorise material from MS221. However, the more notation and terminology you can remember and understand, the easier you will find it to study the MS221 materials and to do assessment questions confidently.

If you are studying MST121 as well, we recommend that you use just the MS221 *Handbook*.

The MS221 *Handbook* includes the material from the MST121 *Handbook*.

It is a good idea either to use a pencil or to use 'Post-it' stickers for your annotations until you are confident which type suits you best. Note, however, that 'Post-it' stickers must be removed before the examination.

If you started MST121 previously, you should change to using the MS221 *Handbook* now.

MS221 website

As well as the MS221 study texts you receive in module mailings, other essential learning resources (such as *Assignment Booklets I and II*) will only be delivered through the MS221 website. The website can be accessed from your StudentHome page. Any last minute news, such as errata, will be provided on the website. You will also find links to the MS221 forums on the website. You should check the MS221 website regularly for updates.

4 Assessment

Components of assessment

There are two components of assessment, each marked out of 100:

- continuous assessment, through four **tutor-marked assignments** (TMAs); each TMA is marked out of 100, and these marks will be combined to give an overall continuous assessment score (out of 100) at the end of MS221
- an **examination**.

TMAs are contained in the **assignment booklets**, which appear on the MS221 website. The *Study planner* gives the dates by which assignments should be completed. The **cut-off date** for a TMA is the last date on which your tutor may accept your work for marking, unless he or she feels that there are exceptional reasons why you should be allowed to submit late. If you are concerned about meeting a deadline, you should contact your tutor well before the cut-off date.

It is important to plan your study to include time to work on the assignments, allowing time to refine and check what you write – and perhaps to act on any advice that you might seek from your tutor.

The examination is a three-hour paper. Details of this will be sent to you nearer the time. There is also a *Specimen Examination Paper* with sample solutions on the MS221 website, to guide your revision.

Your overall grade

Your overall grade depends on your performance in *both* the continuous assessment and the examination. You will be awarded a mark for each TMA that you submit. These marks are combined with your mark from the examination to give an overall grade for MS221.

Note that your overall grade may be improved by **substitution**. Under this system, your lowest TMA mark is replaced by a 'substitution mark' (if this is higher), computed from all your TMA marks for MS221, and only then is your overall grade computed. If substitution would benefit your overall score, the process is carried out automatically. The effects of this system are that:

- you are not penalised too severely for one low TMA mark
- it is advantageous to submit **all** the TMAs, even if you are not able to do yourself justice on some parts.

MS221 is a level 2 course, so one of five grades can be awarded: each of grades 1–4 is a pass and grade 5 is a fail.

If you are awarded grade 5, but have achieved satisfactory marks on the continuous assessment and a mark on the examination that is not too far below a pass, then you will be entitled to carry your continuous assessment marks forward and resit the examination at a later stage.

Consult the *Assessment Handbook* for further information on these matters.

Consult the Assessment Calculator from your StudentHome page to see how this works in practice.

You will also receive useful feedback.

5 Study support

Your tutor

Your tutor's name and email address will be displayed on your StudentHome page. Your tutor will contact you to introduce themselves and to give you the address to which you should post your TMAs. Every TMA that you submit on time should be returned marked by your tutor, with comments. These comments should point out what you have done well, while indicating any misunderstandings and errors and giving advice on how to avoid these. TMAs are the basis for correspondence tuition, and should enable you to establish a dialogue with your tutor.

You will receive details of other ways in which your tutor may offer you support, for instance with tutorials or computer forums (see 'MS221 website' and 'Study planner'). You will be able to obtain details of tutorials provided by other tutors, which you are entitled to attend. You are strongly encouraged to participate in tutorials, if it is feasible for you to do so, as they provide an opportunity to receive focused tuition, to work with other students, and to discuss your own questions.

If it is impossible for you to take part in organised activities, please make contact with your tutor, and maintain contact through telephone, email or, if you have the equipment, using Elluminate software. Your tutor will be able to advise on the most suitable method for you.

Other students

You will have access to an online forum where you can discuss MS221 with other students. This online forum is an ideal way for students to help each other by asking questions, or by providing study tips. The forum can be used to discuss all aspects of MS221 and of mathematics in general, but should not be used to discuss answers to TMA questions.

Other support

If you experience difficulties that are not related to MS221, you are welcome to contact your Learner Support Team – see your StudentHome page for details.

Computing support

If you need help with any aspect of using your computer to study, a good place to start is the OU's Computing Guide, at www.open.ac.uk/computingguide.

If you get stuck, contact the OU Computing Helpdesk, which provides technical support for the MS221 computer resources and other OU-provided IT services and applications, including online forums and tutorials, problems with usernames or passwords, and access to websites and other online facilities. Help with system or hardware queries (e.g. your internet connections, formatting hard drives, installing hardware or operating systems, etc.) is not provided. Contact details are available via your StudentHome page.

For queries about Mathcad, please consult the MS221 website.

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